Design and Simulation of Automated Packaging Machine Process Control by Using PLC

Hnin Yu Lwin, U Hla Myo Htay

Electrical Power Department, Technological University, Mandalay, Myanmar

ABSTRACT

Industry automation becomes the global trend in manufacturing and packaging process is one of the uses in industry. Modern industrial plants require the automatic process control system to control the desired process. The programmable logic controller (PLC) is very useful for the industrial automation in the modern business world. Industrial automation plays an important role in increasing the yield of a product. And then, among the controlling systems, the PLC control system has more applications than the other numerical control systems. It can be observed that a circuit has a fault by checking the control panel board. Troubleshooting can be done quickly visual observation. The main idea of the paper is to automate the process for packaging the detergent that weights 85 kg. Programmable logic controller SIEMENS SIMATIC S7-300 CPU 214C-2PN/DP AC/DC/relay was used to control and automate this machine by ladder logic diagram software. In this paper, TIA portal (V-13) software is used as programming software.

KEYWORDS: Programmable Logic Controller (PLC), Automatic Packaging Machine, Ladder Logic Diagram Software

1. INTRODUCTION
The automatic packaging machine system is a combination of electronic, electrical and mechanical parts. Industry automation becomes the global trend in manufacturing, packaging process is one of the most uses in industry; more and more companies are switching to automation.

Automation is to use control systems and information technologies to reduce the need for human work in production of goods and services. Automation plays an increasingly important role in the world economy and in daily experience. This thesis is devoted to the use of automatic control system in process machine system; the control system will pay a major role in control on all parts of the machine. Electrical AC motors control were used as actuators for the entire process and the sensors used to feed the control system by system information.

Input devices are devices used to gather information about the system, which consists switches (toggle switch) and sensors (photo and inductive sensor), in order to feed the controller (PLC) by an information about the belts status and objects. The controller, which is the main element that operate the whole system. By using the information from the sensors to take the counting and movement decision before sending the orders to the output devices by the actuators and the relays. Output devices are the actuators that converts an electrical signal into mechanical movement; the principle types of actuators are relay, solenoid, and motors.

Programmable logic controllers are now the most widely used industrial process control technology. A programmable logic controller (PLC) is an industrial grade computer that is capable of being programmed to perform control functions. Every aspect of industry, from power generation to automobile painting to food packaging uses programmable controllers to expand and enhance production. The basis of

programmable controllers from their operation connected to their vast range of applications. Control engineering has been developing for a long time. More recently electricity has been used for control and early electrical control was based on relays. These relays allow power to be switch on and off without a mechanical switch. It is common to use relays to make simple logical control decisions. The Programmable logic Controller (PLC), a low cost computer, which has brought most recent revolution, can easily be bought.

Programmable Controllers can be considered newcomers when days are compared to their elder predecessors in traditional control equipment technology, such as old hardwired relay systems, analog instrumentation, and other types of early solid state logic. Although PLC functions such as speed of operation, types of interfaces, and data processing capabilities have improve throughout the years, the designers' original intentions are still holding their specifications.

PLCs have become popular on the factory floor and will probably remain predominant for some time to come. Among the advantages, they offer to be affective concentration to the operator. These are It is cost effective for controlling complex system. It is flexible to control other systems quickly and easily. It has computational abilities to allow more sophisticated control. Trouble shooting aids make programming easier and reduce downtime. Reliable components likely to operate for several years before failure. There have been many technological advances in the

programmable controller industry. These advances affect not only programmable controller design, but also philosophical approach to control systems architecture. A typical PLC control panel, which replaces the relay panel, performs the same logic control task. The wiring to the process is the same for each type of control. However, the PLC is smaller and more reliable. For control system logic changes, the relay panel must be rewired, whereas the PLC can quickly be reprogrammed for any changes.

Packaging system with high automation will be a future trend of industries in this country. For discrete process control of automation, the PLC will mainly be used. Programmable controllers are generally programmed in ladder diagram. No rewiring is required for a PLC control system. Therefore, PLC control system can save the valuable factory time and can improve the control system of the automated packaging machine.
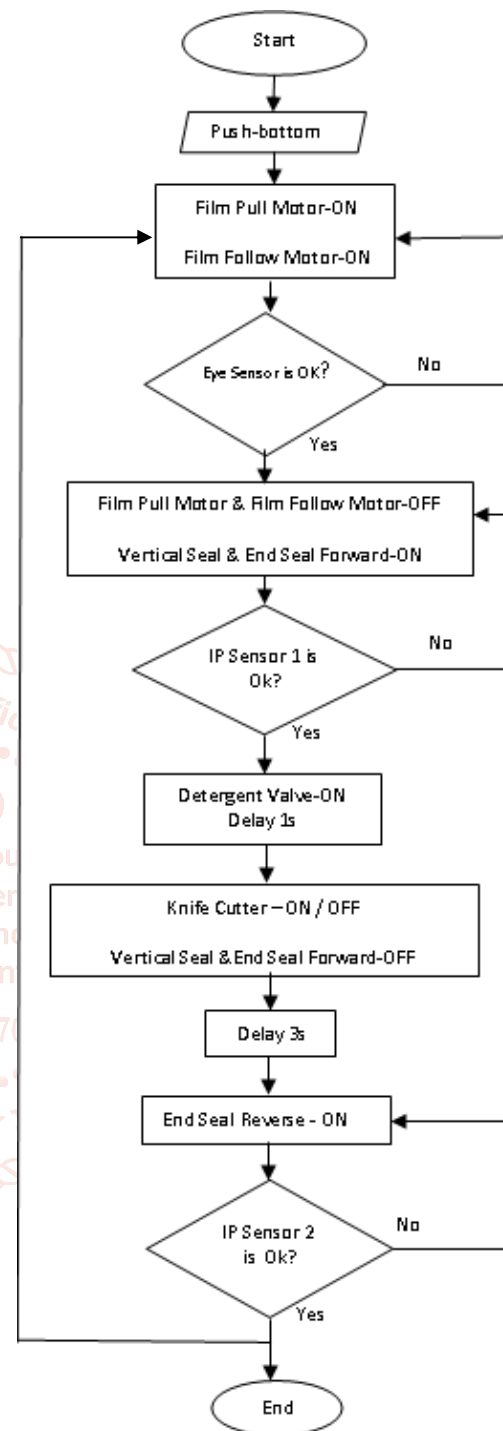
2. Parts and Control of Automatic Packaging Machine
There are many parts of automatic packaging machine (JATON JW-600).These are Emergency stop switch, Circuit breaker, Servo motor, Pneumatics, Heat sealer, Knife (Cutter) and Relays.

The S7-300 CPU is used to control in this system. It can be support the programming languages such as Statement List (SLT), Ladder logic (LDA), Structure Control Language (SCL), Function Block Diagram (FBD) and S7 Graph.
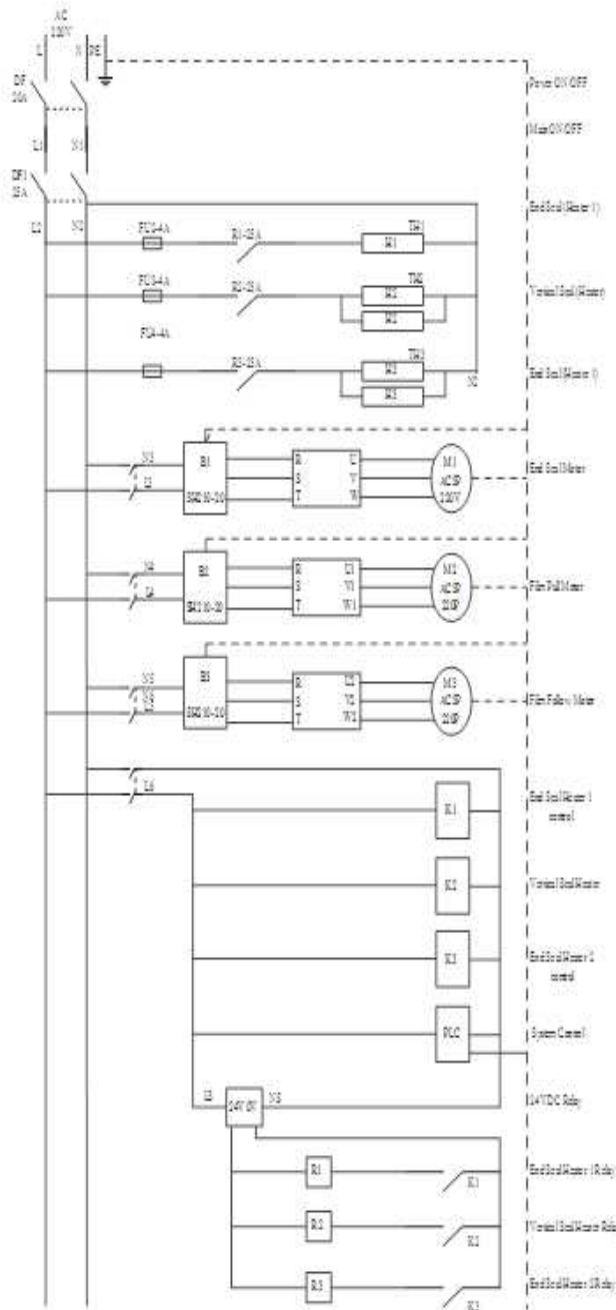
3. Operation and Simulation Results

| Packaging Way	Vertical sealing and end sealing
Weight of powder	85kg
Conveyor	Front Roller Conveyor, Rear Belt Conveyor
Scrap Film Speed	0mm-25mm/min (Adjustable)
Power Supply	AC/3-phase 400V,50/60Hz
Air Pressure Source	6kg/cm^2
In-feed Roller Conveyor Motor	AC/3-phase, 400V, 4P,120W (with brake)
Out-feed Conveyor Belt Motor	AC/3-phase, 400V, 4P,120W (with brake)
Film Drive Motor	AC/3-phase, 400V, 4P,90W (with brake)
Heating Element	AC/single phase, 400V, 1200W
Site Heating Element	AC/single phase, 400V, 1100W
Working Table Height	650-680mm
Dimension length(mm)	600mm
Width(mm)	400mm
Height(mm)	120mm
Scrap Retrieve	Unwind film
Shrinkable Film Dimensions	W=750 m/m (max.)

Specifications of Automated Packaging Machine

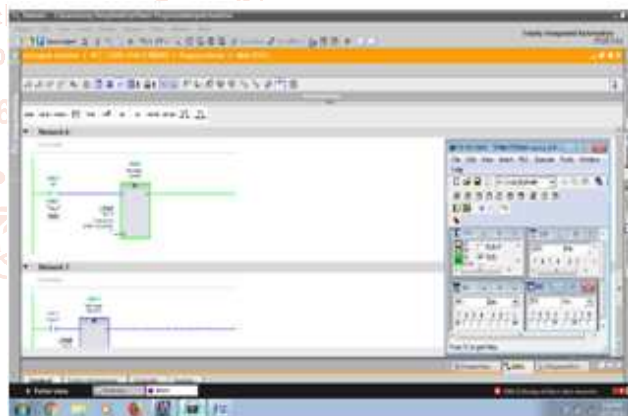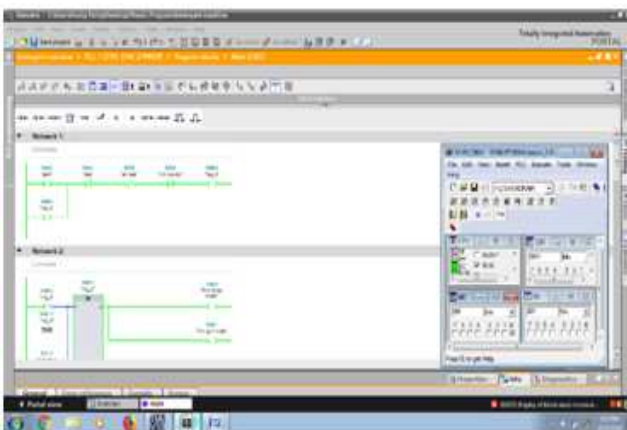Process Flow Chart of Control Program

Simulation Result for End Seal Forward, Vertical Seal and Knife
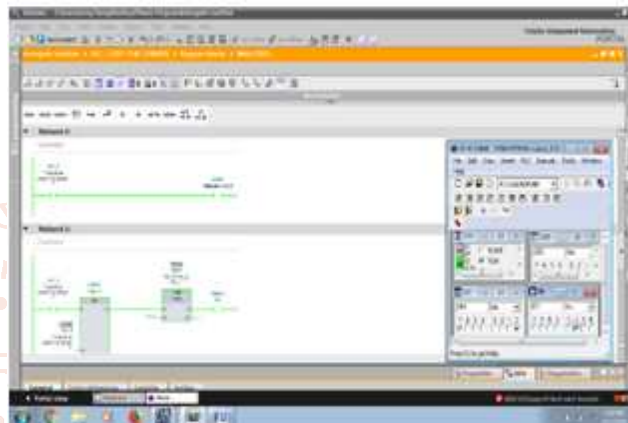
Simulation Result for Detergent Valve

Simulation Result for End Seal Reverse

Overall Circuit Diagram of Automatic Packaging Machine Control System

Simulation Result for Film Follow Motor and Film Pull Moto
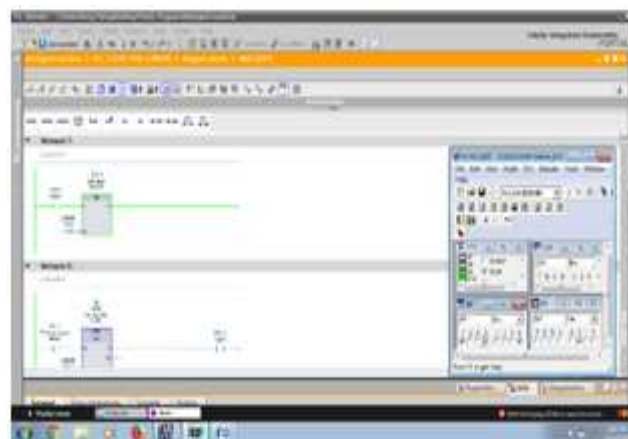
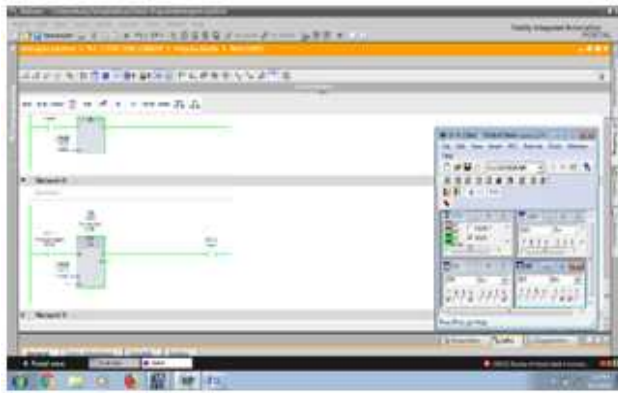Simulation Result for Conveyer Forward

Simulation Result for Counter

4. Conclusion

The automated packaging machine is programmed with 14 inputs and 20 outputs by SIEMENS S7 300 PLC. But most of failures are connected to the inner wiring circuit which can be less. However, the program control switch cannot be working together an operator as well. In this research work, the programmable logic controller is widely used in the developing industrial types. The PLC control system can be programmed with the different languages. The abilities of control system are based on many kinds of PLC programming. Thus, it can be observed that PLC takes the important role in factory automation process and control system. It is believed that the studies in this thesis will give more understanding upon PLC programming and operation. In conclusion, the research work can be well shown the automated packaging machine with PLC ladder language.

5. ACKNOWLEDGEMENTS

REFERENCES

[1] [03Joh] John: Programmable logic controllers principles and applications

[2] [05Hug] Hugh Jack: Automating Manufacturing Systems with PLCs, MC Grall Hill, (2005).

[3] [06Ano] Anonymous: Programmable Logic Controller Controllers, Training Manual, Basic Course (for GX Developer), January, 2006,

[4] [11Hug] Operation Instructions of CHM1000E Type Automated Packaging Machine, (2011).

[5] [14Kar] Karnataka, H.: "PLC controlled low cost automatic packing", International Journal of advanced mechanical engineering, vol. 4, no.7, PP.803-811, (2014).